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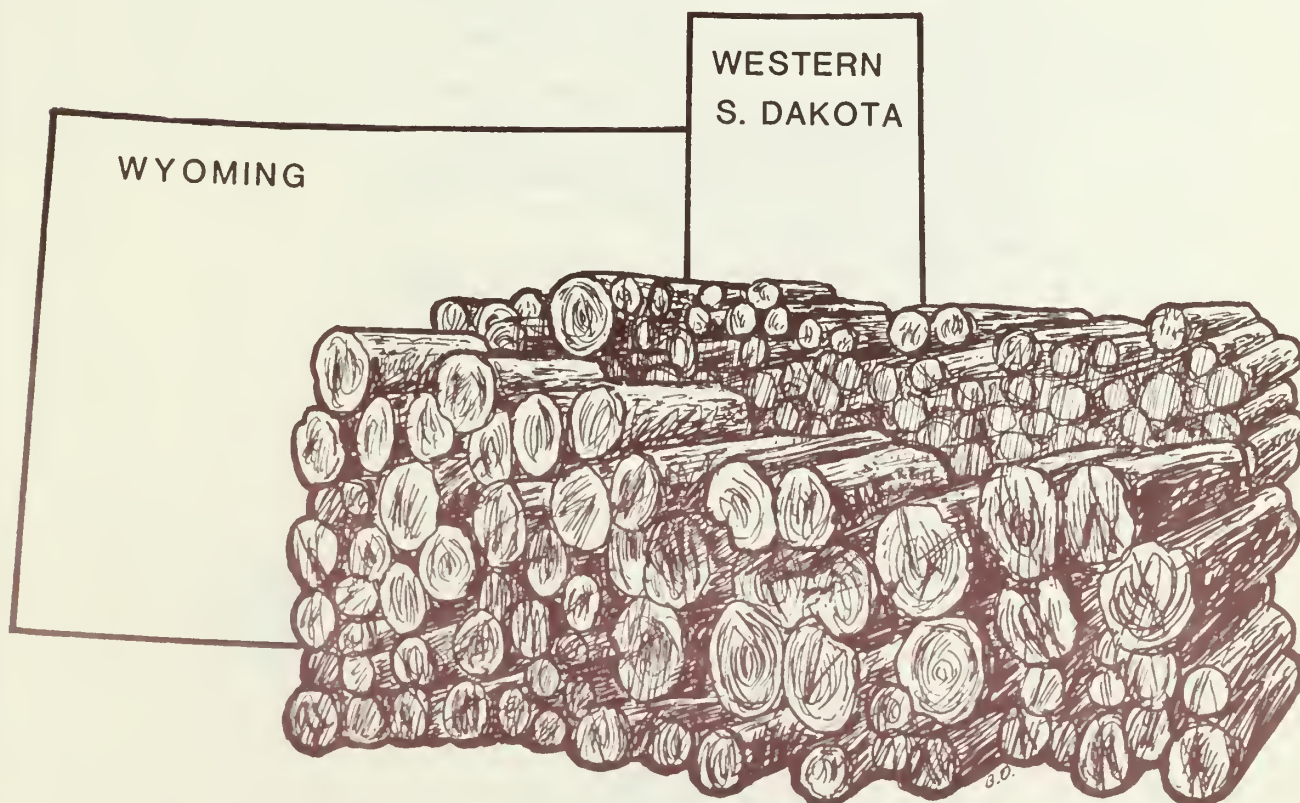
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Wyoming and Western South Dakota's 1983 Fuelwood Harvest

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1. The owners and operators of Wyoming's and South Dakota's primary wood processing industries.
2. The commercial fuelwood operators of Wyoming and South Dakota who responded to our inquiries.
3. The members of the 400 households sampled in each State who provided us data.
4. The Wyoming Timber Industry Association, the Wyoming State Forestry Division, the South Dakota Department of Agriculture/Division of Forestry, and the staffs of the many USDA Forest Service Districts and Forests in Wyoming and South Dakota for supplying us with information and referrals.

RESEARCH SUMMARY

The estimated fuelwood harvests in Wyoming and western South Dakota in 1983 were 143,000 cords (10 million cubic feet) and 46,000 cords (3.5 million cubic feet), respectively.

In Wyoming, the fuelwood harvest volume was one-third the volume of sawlogs and other industrial roundwood products harvested. The volume of live timber trees harvested for fuelwood was only 16,000 cords (1.1 million cubic feet), only 3 percent of the total harvest of roundwood products in 1983.

In western South Dakota, the fuelwood harvest volume was 15 percent of the industrial roundwood harvest. The volume of live timber trees harvested for fuelwood was only 5,200 cords (379,000 cubic feet), less than 2 percent of the total harvest of roundwood products in 1983.

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INTRODUCTION

The Forest Survey Unit at the Intermountain Research Station is charged with making comprehensive surveys and analyses of the forest resource situation in the Rocky Mountain States (fig. 1). Periodic annual estimates and descriptions of wood harvests are part of this mission.

In 1984, tree harvest data for calendar year 1983 were collected for Wyoming and western South Dakota to coin-

cide with the 1983 forest inventories of those States. The inventories provide the data to estimate and describe the volume, growth, and mortality of the forests' trees; the tree harvest data are used to assess and describe the changes in the forests' tree volumes due to harvesting. The fuelwood (firewood) harvest, one segment of tree harvesting, is the focus of this report.



Figure 1—Rocky Mountain States.

Residential use of firewood in the United States declined from 1880 until the mid-1970's (USDA Forest Service 1982). For over 10 years, since the 1973 oil embargo, the use of fuelwood for home heating (and industrial energy production) has increased, sometimes dramatically (McLain and Booth 1985). Consequently, more elaborate data-gathering efforts were used to estimate the 1983 fuelwood harvest in Wyoming and South Dakota than were used in previous studies.

As in past studies, operators of primary wood processing plants, such as sawmills, were canvassed by mailed questionnaires to obtain harvest data for timber products¹ and fuelwood. For this study, potential commercial fuelwood operators were also canvassed by mail and the citizenry polled by mail and telephone.

RESULTS FOR WYOMING

In 1983 an estimated 143,000 cords of fuelwood (tables 1 to 3) were harvested in Wyoming. At a conversion rate of 72,516 cubic feet² of wood per cord, this amounts to over 10 million cubic feet, equivalent to one-third the 1983 Wyoming harvest of sawlogs and other industrial roundwood products (30 million cubic feet) (McLain in press). This is considerably larger than the fuelwood harvest estimates for 1962 and 1969 (the 1969 estimate included posts and miscellaneous farm timbers) of 0.1 and 0.5 million cubic feet (Choate 1963; Setzer 1971).

Table 1—Total volume of fuelwood harvested in Wyoming by land class/owner and county, 1983, in cords

County	Land class and owner					Total
	National Forest	Bureau of Land Management	Other public ¹	Private	Nonforest ²	
	----- Cords -----					
Albany	16,816	2,915	—	2,589	—	22,320
Big Horn	2,612	80	—	—	—	2,692
Carbon	16,122	1,358	—	1,458	—	18,938
Converse	2,262	905	—	2,715	—	5,882
Crook	2,530	—	—	265	—	2,795
Fremont	10,809	100	—	7,240	9,050	27,199
Goshen	—	—	—	2,262	—	2,262
Hot Springs	—	—	—	1,810	—	1,810
Johnson	7,758	200	—	3,674	—	11,632
Laramie	905	—	—	1,584	60	2,549
Lincoln	4,246	—	163	—	—	4,410
Natrona	—	9,729	1,412	1,014	—	12,156
Park	3,568	1,358	—	679	—	5,604
Platte	—	—	—	154	—	154
Sheridan	10,181	—	—	—	—	10,181
Sublette	7,327	—	—	452	—	7,780
Sweetwater	—	955	—	—	—	955
Teton	2,838	—	—	679	—	3,516
Weston	—	—	—	226	—	226
Total	87,976	17,599	1,576	26,801	9,110	143,061

¹Lands managed by the State of Wyoming and lands managed by Federal agencies other than the Forest Service and the Bureau of Land Management.

²Includes orchards, city parks, urban areas, and windbreaks.

¹Timber products, also termed industrial roundwood products, are round sections cut from trees for industrial or consumer use. Timber products generally include sawlogs, house logs, utility poles, pulpwood, posts, building poles, mine timbers, and excelsior bolts.

²Standard conversion rate used in Blackhills area by USDA Forest Service; applied to western Wyoming also, for lack of anything better.

Table 2—Total volume of fuelwood harvested in Wyoming by land class/owner and species, 1983, in cords

Species	Land class and owner					Total
	National Forest	Bureau of Land Management	Other public	Nonforest	Private	
	----- Cords -----					
True firs	522	—	—	—	—	522
Spruce	1,970	—	—	—	50	2,020
Lodgepole pine	59,843	3,518	1,448	—	6,754	71,563
Limber pine	—	—	—	—	54	54
Ponderosa pine	18,167	12,896	15	—	736	31,814
Douglas-fir	—	280	—	—	—	280
Cottonwood	—	452	113	60	14,783	15,409
Aspen	6,082	452	—	—	4,364	10,899
Other hardwoods	1,390	—	—	9,050	60	10,501
Total	87,976	17,599	1,576	9,110	26,801	143,061

Table 3—Total volume of fuelwood harvested in Wyoming by species and county, 1983, in cords

County	Species									Total
	True firs	Spruce	Lodgepole pine	Limber pine	Ponderosa pine	Douglas- fir	Cottonwood	Aspen	Other hardwoods	
	----- Cords -----									
Albany	452	100	16,308	—	4,781	—	452	226	—	22,320
Big Horn	70	—	1,638	—	905	80	—	—	—	2,692
Carbon	—	1,408	13,458	—	452	—	—	3,620	—	18,938
Converse	—	—	2,715	—	1,358	—	1,810	—	—	5,882
Crook	—	—	1,131	—	148	—	—	65	1,451	2,795
Fremont	—	—	10,004	—	905	—	4,525	2,715	9,050	27,199
Goshen	—	—	—	—	—	—	2,262	—	—	2,262
Hot Springs	—	—	—	—	—	—	1,810	—	—	1,810
Johnson	—	—	2,102	54	5,204	200	3,620	452	—	11,632
Laramie	—	—	—	—	905	—	60	1,584	—	2,549
Lincoln	—	—	2,713	—	905	—	113	679	—	4,410
Natrona	—	—	2,072	—	10,083	—	—	—	—	12,156
Park	—	—	4,725	—	—	—	679	200	—	5,604
Platte	—	—	77	—	—	—	77	—	—	154
Sheridan	—	452	4,299	—	4,978	—	—	452	—	10,181
Sublette	—	—	6,816	—	59	—	—	905	—	7,780
Sweetwater	—	—	50	—	905	—	—	—	—	955
Teton	—	60	3,456	—	—	—	—	—	—	3,516
Weston	—	—	—	—	226	—	—	—	—	226
Total	522	2,020	71,563	54	31,814	280	15,409	10,899	10,501	143,061

The Wyoming fuelwood harvest is a significant proportion (25 percent) of the total State's roundwood production (industrial roundwood and fuelwood) of 40 million cubic feet. However, it is not so significant that it is a drain on the growing-stock³ inventory of Wyoming forests or in competition with the forest products industry for wood fiber. Most of the fuelwood harvest was dead trees or nontimber trees (pinyon, juniper, and all hardwoods except cottonwood and aspen).

The fuelwood harvest of standing live trees of timber species⁴ from forest land (excludes orchards, city parks, urban areas, and windbreaks) was under 16,000 cords (1.1 million cubic feet), 11 percent of the total fuelwood harvest, less than 4 percent of the roundwood harvest of live trees (29.5 million cubic feet), and only 3 percent of total 1983 roundwood production (40.4 million cubic feet—fig. 2). Of the remaining 127,000 cords of fuelwood harvested,

117,000 were from dead trees of timber species and 10,500 were from nontimber trees.

Personal consumption accounted for 96 percent (138,000 cords) of the fuelwood cut. Commercial operators reported harvesting 5,000 cords.

Lodgepole pine represented 50 percent of the harvest with 71,500 cords cut (tables 2 and 3, fig. 3), followed by ponderosa pine (22 percent), cottonwood (11 percent), aspen (8 percent), and nontimber hardwoods such as oak and elm (7 percent).

National Forests produced 61 percent (88,000 cords) of the fuelwood harvest (tables 1 and 2), private lands 19 percent, and lands managed by the Bureau of Land Management, U.S. Department of the Interior, 12 percent.

The leading counties in fuelwood production were Fremont with 19 percent (27,000 cords) (tables 1 and 3, fig. 4), Albany 16 percent, and Carbon 13 percent.

INDUSTRIAL ROUNDWOOD HARVEST

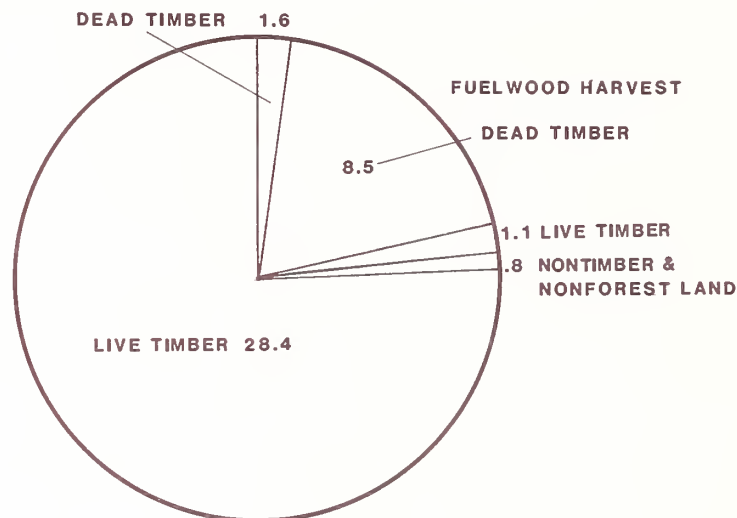


Figure 2—A comparison of the tree class composition of the fuelwood harvest and the industrial roundwood harvest of Wyoming, 1983, in million cubic feet. Timber: tree species traditionally harvested for lumber products, such as ponderosa pine, Douglas-fir, and lodgepole pine. Nontimber: trees other than timber trees (pinyon, juniper, and all hardwoods except cottonwood and aspen). Nonforest land: orchards, city parks, urban areas, and windbreaks.

³Growing-stock volume is the net cubic-foot volume of wood in live trees from a stump 1 foot high to a 4.0-inch diameter top, outside bark. Such trees must be timber trees, those traditionally harvested for lumber products (excludes pinyon, juniper, ornamentals, and fruit trees), must have a central stem at least 5 inches in diameter at breast height (d.b.h.), and must meet specified standards of quality and vigor, thus excluding cull trees.

⁴Includes tree species traditionally harvested for lumber products, such as ponderosa pine, Douglas-fir, lodgepole pine, cottonwood, and aspen. Excludes pinyon, juniper, and miscellaneous hardwoods such as oaks, shade trees, ornamentals, and fruit trees.

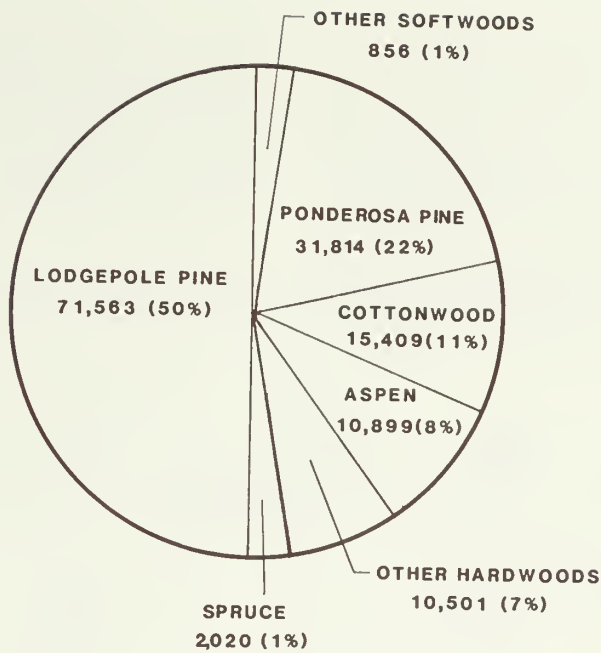


Figure 3—Species distribution of the fuelwood harvest in Wyoming, 1983, in cords and percentage.

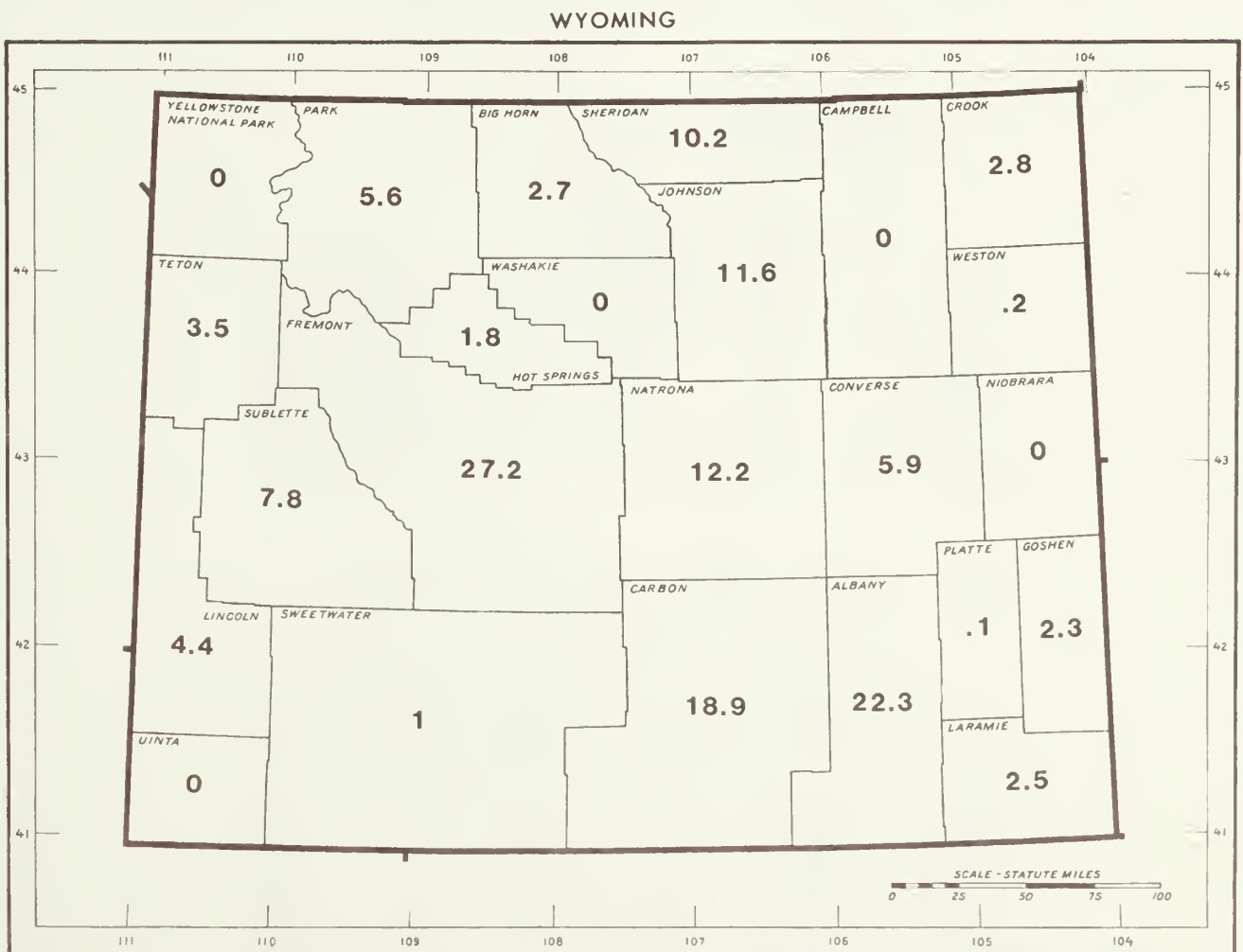


Figure 4—Wyoming fuelwood harvest by county in thousands of cords, 1983.

RESULTS FOR WESTERN SOUTH DAKOTA

More than 46,000 cords of fuelwood were estimated to have been cut in western South Dakota in 1983 (tables 4-6). This converts to 3.3 million cubic feet at 72.516 cubic feet/cord, equivalent to 15 percent of the volume of the

1983 industrial roundwood harvest of 23.1 million cubic feet (McLain in press), up from the 1969 and 1974 fuelwood harvest estimates of 2.4 and 1.7 million cubic feet (Setzer 1971; Setzer and Barrett 1977). (The 1969 estimate included poles, piling, posts, and fuelwood; the 1974 estimate, posts and fuelwood.)

Table 4—Total volume of fuelwood harvested in western South Dakota by owner and county, 1983, in cords

County	Owner				Total
	National Forest	Bureau of Land Management	State	Private	
----- Cords -----					
Butte	—	—	—	2,336	2,336
Custer	1,875	—	519	1,817	4,211
Fall River	—	—	—	5,825	5,825
Harding	649	—	—	—	649
Lawrence	7,534	—	—	3,667	11,201
Meade	3,760	389	—	1,787	5,937
Pennington	6,347	—	—	9,864	16,212
Total	20,166	389	519	25,297	46,371

Table 5—Total volume of fuelwood harvested in western South Dakota by species and owner, 1983, in cords

Species	Owner				Total
	National Forest	Bureau of Land Management	State	Private	
----- Cords -----					
Ponderosa pine	17,630	260	519	17,460	35,868
Cottonwood	—	—	—	3,878	3,878
Aspen	1,562	—	—	130	1,692
Other hardwoods	973	130	—	3,829	4,932
Total	20,166	389	519	25,297	46,371

Table 6—Total volume of fuelwood harvested in western South Dakota by species and county, 1983, in cords

County	Species				Total
	Ponderosa pine	Cottonwood	Aspen	Other hardwoods	
	----- Cords -----				
Butte	—	1,168	—	1,168	2,336
Custer	3,951	—	—	260	4,211
Fall River	3,212	1,639	—	973	5,825
Harding	649	—	—	—	649
Lawrence	8,632	32	1,303	1,233	11,201
Meade	4,639	519	130	649	5,937
Pennington	14,784	519	260	649	16,212
Total	35,868	3,878	1,692	4,932	46,371

Only 5,200 cords (379,000 cubic feet) or 11 percent of the fuelwood came from live timber trees. This was less than 2 percent of the total roundwood production of live timber trees, 23.3 million cubic feet. Dead timber trees accounted for 78 percent of the fuelwood harvest, 36,200 cords. Nontimber trees contributed over 10 percent (4,900 cords) to fuelwood production (fig. 5).

The harvest for personal use was just under 44,000 cords (94 percent). The remaining 2,700 cords were cut by commercial firewood operators.

Ponderosa pine at 36,000 cords (77 percent) was the most heavily harvested species, followed by 4,900 cords of nontimber species such as oak, ash, birch, and fruit trees (tables 5 and 6).

More than half (25,000 cords) of the fuelwood was cut on privately owned land (tables 4 and 5). National Forest land produced 20,000 cords (43 percent).

Pennington with 16,000 cords (35 percent) and Lawrence with 11,000 cords (24 percent) led in the production by county (tables 4 and 6, fig. 6).

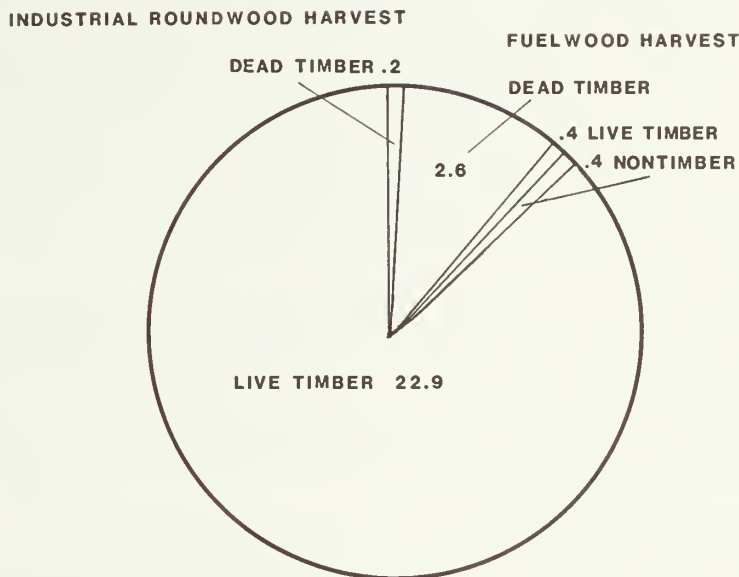


Figure 5—A comparison of the tree class composition of the fuelwood harvest and the industrial roundwood harvest of western South Dakota, 1983, in million cubic feet. Timber: tree species traditionally harvested for lumber products, such as ponderosa pine, Douglas-fir, and lodgepole pine. Nontimber: trees other than timber trees (pinyon, juniper, and all hardwoods except cottonwood and aspen).

SOUTH DAKOTA

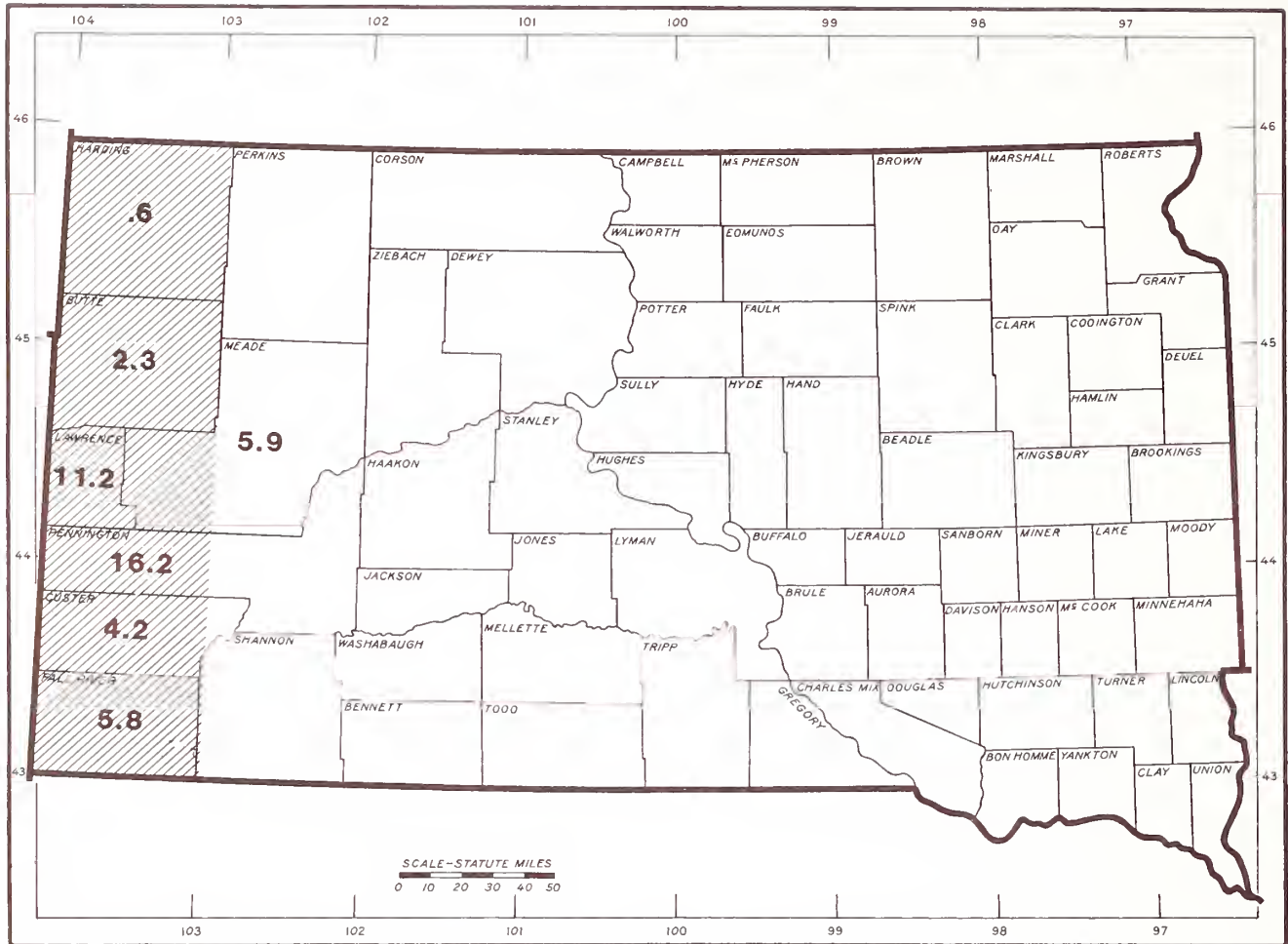


Figure 6—Fuelwood harvest by county, western South Dakota, in thousands of cords, 1983.

SURVEY PROCEDURES

Fuelwood harvest data were collected from two distinct groups: commercial operators who harvest fuelwood and other roundwood products to sell to consumers or retail outlets; and members of households who harvest fuelwood and consume it. These two populations were surveyed in different ways.

Fuelwood Harvest by Commercial Operators

We attempted a 100 percent canvass of commercial operators to obtain the data from this population. Commercial fuelwood operators comprised multiproduct roundwood harvesters and those who harvest strictly, or predominantly, fuelwood.

We canvassed primary wood processing plants, such as sawmills, to obtain the multiproduct roundwood data that included fuelwood. These plants (mills and yards) were identified from "The 1980-81 Wyoming Timber Industries Directory," updated by the Wyoming Timber Industry Association and the Wyoming State Forestry Division,

from a directory of sawmills supplied and updated by the South Dakota Department of Agriculture/Division of Forestry, and from information supplied by National Forest personnel in Wyoming and South Dakota. None of the mills that reported receiving roundwood harvested in Wyoming (43) reported receiving fuelwood, and only one mill receiving roundwood from South Dakota (18) reported fuelwood as a product.

Most of the commercial fuelwood harvest was reported by individuals and businesses identified from bidders lists supplied by National Forest, Bureau of Land Management, and State forestry personnel. Of those identified as potential 1983 commercial fuelwood harvesters, 31 responded as harvesting in Wyoming and five as harvesting in South Dakota in 1983.

Fuelwood Harvest by Members of Households for Personal Use

To obtain personal-use fuelwood harvest estimates, we surveyed residents of 400 households in Wyoming and 400 in South Dakota. The populations sampled consisted of all

residential listings in all Wyoming telephone books and in those South Dakota telephone directories that covered the population in the area of the State likely to have harvested in South Dakota west of the 103d meridian (western South Dakota). A random number generator⁵ was used to select the sample, which was distributed throughout the telephone books proportional to the populations of households (residences) within the books.

Of the 400 households surveyed in each State, 86 in Wyoming and 71 in South Dakota reported fuelwood harvests for 1983.

The following procedure was used to expand the sample statistics to obtain the estimate of the total volume of fuelwood harvested by all the households in Wyoming and the households within and adjacent to the area west of the 103d meridian in South Dakota:⁶

n = number of households in sample

nc = number of households in sample that harvested fuelwood

$\sum X$ = reported harvest by nc in cords

\bar{X} = mean harvest, in cords, by nc ²

$$\bar{X} = \frac{\sum X}{nc}$$

N = estimated population of residences (households) in all the telephone books in Wyoming (western South Dakota)

$$NC = N_n^{nc}$$

⁶ VOL = estimated volume of fuelwood harvested by N

$$VOL = NC(\bar{X})$$

P = Bureau of Census estimate of the population of households in Wyoming (western South Dakota)

K = population adjustment factor; used to expand the estimate of harvest by the telephone book population to the estimate of harvest by the population of Wyoming (western South Dakota)

$$K = \frac{P}{N}$$

⁶ $TOT VOL$ = estimate of the total volume harvested by members of households (in Wyoming (western South Dakota)) for personal consumption

$$TOT VOL = VOL(K)$$

$$\text{or: } TOT VOL = \frac{P}{n} \sum X.$$

Table cells are found by merely multiplying reported volumes by the expansion factor:

$$\text{Expansion factor} = \frac{TOT VOL}{\sum X} = \frac{P}{n}$$

For the 1983 harvest of fuelwood by households, the following were computed:

Wyoming

$$\begin{array}{ll} n = 400 & \text{Expansion} \\ nc = 86 & \text{factor} = 452.5 \end{array}$$

$$\sum X = 320.129$$

$$\bar{X} = 3.7224$$

$$N = 169,427$$

$$NC = 36,427$$

$$VOL = 135,596$$

$$P = 181,000$$

$$K = 1.0683$$

$$TOT VOL = 144,858.$$

Western South Dakota

$$\begin{array}{ll} n = 400 & \text{Expansion} \\ nc = 71 & \text{factor} = 129.792 \end{array}$$

$$\sum X = 312.879$$

$$\bar{X} = 4.40675$$

$$N = 53,802$$

$$NC = 9,550$$

$$VOL = 42,084$$

$$P = 51,917$$

$$K = 0.964964$$

$$TOT VOL = 40,609.$$

The variances, standard errors, and confidence intervals of the estimates of the total volumes harvested by households are found as follows:

$VAR TOT VOL$ = variance of the total volume

$$VAR TOT VOL = \frac{(X)^2(NC)(N-NC)}{n} + \frac{(NC)^2(VAR)}{nc} K^2$$

Std. error $TOT VOL$ = standard error of the total volume

$$= \sqrt{VAR TOT VOL}$$

For 95 percent confidence interval of the estimate of the total volume:

$$TOT VOL \pm 2 (\text{std. error } TOT VOL).$$

For the 1983 harvests of fuelwood by households, the following statistics were calculated:

Wyoming

$$VAR TOT VOL = 322,074,000$$

$$\text{Std. error } TOT VOL = 17,946$$

$$95 \text{ percent confidence interval} = \pm 35,892$$

Western South Dakota

$$VAR TOT VOL = 46,891,700$$

$$\text{Std. error } TOT VOL = 6,848$$

$$95 \text{ percent confidence interval} = \pm 13,696.$$

⁵Copies of the program used to select the actual sample are available from Gordon D. Booth, Statistics/Computer Science Group, Intermountain Research Station.

⁶This is not necessarily the volume harvested in Wyoming and western South Dakota. Some of the fuelwood harvest reported by the populations sampled took place in Utah, Montana, and Colorado. These "outside" harvest volumes were included in calculations of the means (\bar{X}) and are thus included in all computations involving \bar{X} . This does not, however, affect the calculation of the harvest volume in Wyoming and western South Dakota.



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The estimated fuelwood harvests in Wyoming and western South Dakota in 1983 were 143,000 cords (10 million cubic feet) and 46,000 cords (3.5 million cubic feet), respectively. In Wyoming, the fuelwood harvest volume was one-third the volume of sawlogs and other industrial roundwood products harvested. In western South Dakota, the fuelwood harvest volume was 15 percent of the industrial roundwood. Survey participants were commercial operators and households.

KEYWORDS: firewood, roundwood, timber products
